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Evaluation of Stem Wounds on 80 year-old White Spruce near Tok, Alaska

Biological Evaluation R10-TP-84
March 2001

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BIOLOGICAL EVALUATION R10-TP-84

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INTRODUCTION

White spruce (*Picea glauca*) trees with resin encrusted stem wounds of unknown origin were observed during a pre-commercial thinning operation conducted by Tanana Chiefs Conference, Inc. Forestry staff in interior Alaska. Wounded trees appeared to be randomly distributed across the allotments. It was not known whether the wounds were caused by mechanical damage or a biological agent, such as a canker fungus. Prior surveys within the allotments have revealed heart rot decay in live white spruce trees (Trummer and Ott 1999). Although presence of wood decay did not appear to be associated with wounds, further sampling was needed for more conclusive results.

In July 1999, Anchorage Forest Health Protection staff and Robert Ott, TCC Forestry staff, assessed wounded trees in two un-thinned Native Allotments. The objectives of the assessment were to: 1) identify the causal agent(s) of the wounds; and 2) determine if the wounds served as infection courts for wood decay fungi.

SITE DESCRIPTION

The study was conducted on two Native allotments (#1 and #4) about 5 miles west of the village of Tok, Alaska (Figure 1). Forest cover on both allotments was an 80 year old, fire-regenerated spruce forest, comprised of 90% white spruce stems and 10% quaking aspen (*Populus tremuloides*) stems. The stand is very dense, with trees >4.5 ft. tall averaging 4,700 stems/acre. The site index of the stand is 60-65 (index age of 100 years).

METHODS

Two transects were randomly located within each of the two allotments, for a total of four transects. Each transect was 10 ft. wide and 100 ft. long, and had a north-south orientation.

Within each transect, all trees $\geq$1.0 inch diameter at breast height (dbh) were assessed. Dbh was recorded for all trees with wounds and for every 10^{th} tree without a wound. For all wounded trees, data were recorded on wound height (ft.), length and width of each wound (in.), presence of resin, wound age, and presence of decay. Wound age and presence of decay were obtained after the wounds were dissected with a chainsaw. Tree diameter and percent of the stem circumference affected at the time of wounding was estimated for 40 dissected wounds.

Summary statistics (mean, standard deviation) were calculated for the pooled data from all four transects. Data were pooled because all of the transects were located within the same forest stand—they did not represent separate populations of trees. A T-test was used to compare the dbh between wounded and non-wounded trees.

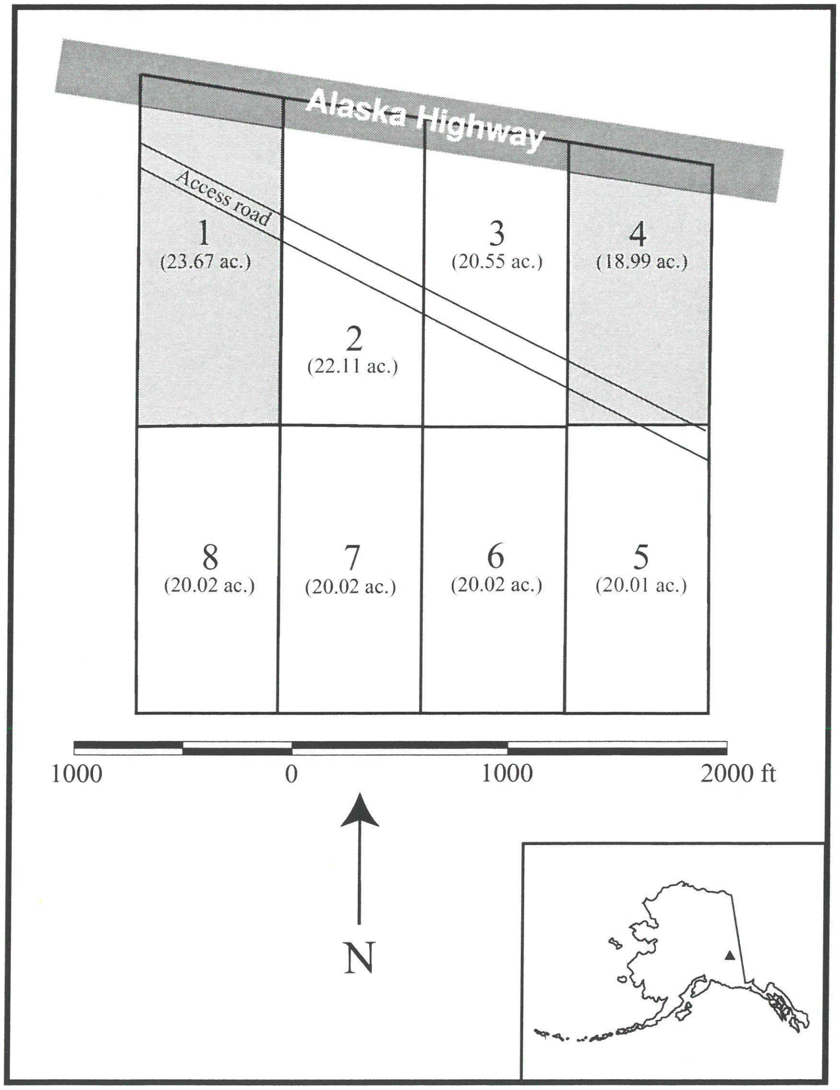

Figure 1. Native allotments (1 and 4) where white spruce stem wounds were evaluated.

RESULTS AND DISCUSSION

Assessments were made on 234 trees. Forty-nine trees (20.9%) exhibited a total of 59 stem wounds. Average dbh of non-wounded trees (2.0 ± 0.7 in.) was not significantly different (*P* = 0.327) from the average dbh of wounded trees (2.4 ± 1.0 in.). At the time and point of wounding, average stem diameter was 1.0 ± 0.5 inches, and maximum stem diameter was 2 inches.

Most wounded trees (75.5%) had only one wound, 11 (22.4%) had two wounds, and one tree (2.0%) had three wounds. Wounds generally occurred low on the tree, averaging 2.5 ± 1.9 ft. above the ground. Shapes of the wounds were roughly diamond or rectangular, and all had old, encrusted resin present (Figure 2). The external surface area of the wound callous averaged 10.4 ± 12.4 in^2. The size of the visible wound does not necessarily reflect actual wound size, and likely overestimates it. The proportion of stem circumference affected averaged 39.9 ± 18.4%.

Figure 2. Resin-encrusted stem wound.

Figure 3. Closed, calloused wound without stem decay.

All wounds lacked decay and had well developed callous tissue (Figure 3). Most wounds were completely closed. Dissections through the callous tissue revealed that the wounds were decades old, averaging 41 ± 15 years. Most wounds appeared to be shallow, affecting the cambium and a minor amount of sapwood. Over time the exposed sapwood was covered with resin, callous tissue, and bark. Weathered, resin-encrusted sapwood was evident in the wound cross-sections as a thin brown discolored section of an annual ring (Figure 3). The

lack of associated wood decay suggests that wounding occurred during winter. Desiccation of exposed woody tissue on the shallow wounds, coupled with low fungal spore loads in the winter, reduced the opportunity for fungal invasion of the injured sites to occur. Resin produced at the site of all wounds assessed in this study may have further "sealed" the injury site from invasion by wood decay fungi.

Debarking by snowshoe hares (*Lepus americanus*) during winter apparently was the cause of all but one of the wounds on the white spruce stems—one wound was caused by a bullet, which was still embedded in the tree. Teeth marks were found on exposed, weathered wood on several of the dissected wounds, and on other unsampled wounds in the area. The low height of the wounds is consistent with the interpretation that wounds were caused by hares. Spruce bark and needles constitute a major component of the winter diet of snowshoe hares in interior Alaska (Wolff 1978), when other food sources are scarce (Trapp 1962). The summer diet of hares, in contrast, consists primarily of herbaceous plant material (Wolff 1978). Other evidence of hare browse damage on spruce, such as clipping of lower branches and terminal leaders, was evident across the allotments (Trummer and Ott 1999) (Figure 4).

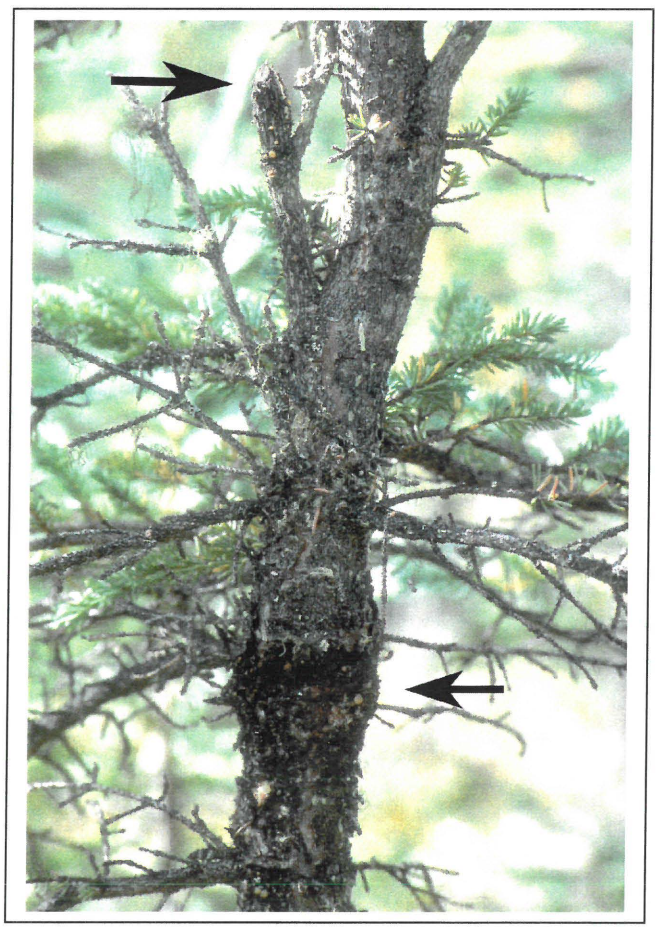

Figure 4. Clipped branch and stem wound caused by snowshoe hare browsing.

MANAGEMENT IMPLICATIONS

Additional stem debarking by snowshoe hares to residual thinned trees within the allotments is not expected to occur due to the size of residual trees. The average tree dbh after thinning was 3.8 inches (Trummer and Ott 1999). In this study, no wounded trees were greater than 2 inches in diameter—and usually much smaller—at the time of injury, suggesting that hares preferentially select small diameter trees for debarking.

Hare populations in interior Alaska are cyclic, with peaks occurring roughly at the turn of each decade, and low densities occurring three years later (Hodges 1999). Hare damage to small trees, such as seedling clipping and stem debarking, can be high during years of peak density (Ott, unpublished data). In Alaska, the survival and recovery of injured trees is not known but is likely related to the extent of the injury. Growth rates of injured trees may be reduced, although the lack of a significant difference between the diameters of wounded and unwounded trees in this study suggests that the growth of wounded trees was not greatly affected. The slow growth rate of trees on this site and the long span of time since injury may have nullified significant difference in diameter between wounded and unwounded trees. Additional surveys assessing the survival and recovery of trees damaged by snowshoe hares in interior Alaska are needed.

Two distinct types of damage, stem debarking and branch clipping, are caused by snowshoe hare browsing of young trees across interior Alaska. These two types of damage result in different probabilities for wood decay invasion of the affected tissues. Results from this study indicate that stem wounds are not readily invaded by wood decay fungi, likely due in part to the shallow wound depth and winter dessication of the wound surface. In contrast, wood decay caused by *Phellinus chrysoloma* has been associated with dead branches and terminal leaders killed by hare browsing (Trummer and Ott 1999). Dead branches provide an avenue for heart rot fungi, such as *P. chrysoloma*, to invade and decay the heartwood in the center of the tree (Percival 1933). Forest managers can utilize this information to assist with predicting internal decay of white spruce in stands that have sustained injuries from snowshoe hares.

Damage by hares is widespread across North America (Crouch 1976). Forest managers across the country have sought remedial measures, with varying success, for reducing the effects of hare browsing on seedlings in managed stands. The following treatments are suggested as options for snowshoe hare control in managed stands (Aldous and Aldous 1944, Crouch 1976).

- Utilize mechanical protection devices such as seedling cages or fences.
- Treat seedlings with chemical repellents.
- Conduct stand release cuttings to eliminate cover for hares and improve seedling growth by reducing vegetative competition.

- Conduct planting or seeding operations two or three years after the hare population peaks. This would provide the young trees an opportunity to grow before the hare population increases again.

- Open sites, several acres in size, are seldom frequented by hares due to the lack of cover. Open sites could be preferentially selected for regeneration during years of high hare population. Conversely, small stand openings and brushy areas adjacent to bogs provide ideal hare habitat. Thus, these areas could be targeted for regeneration during years of low hare populations.

- Various direct control methods for hares, such as hunting, trapping or snaring, may be effective short-term options within a limited landscape area.

ACKNOWLEDGEMENTS

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